# ACQUISITION OF SURFACE CHARACTERIZATION EQUIPMENT

AFOSR GRANT NUMBER: F49620-98-1-0329

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*Abstract*

This project has purchased equipment for the characterization of selected physical, mechanical and crystallographic properties near the surface, that are important in many engineered materials. This equipment supports graduate student education at both the M.S. and PhD levels, on topics which are presently funded by DOD as well as related topics funded elsewhere. The research supported by this equipment focuses on the interrelationships between the physical, chemical, and microstructural state near surfaces and interfaces, and the mechanical behavior of the materials. The DOD-funded project develops the physical understanding of the crack growth events in polycrystalline ceramic monoliths for modeling at the micromechanical level. Related projects include the development of microstructures for improved mechanical behavior, adhesion of ceramic coatings and nano- and microstructural studies of damage development in static and cyclic loading environments.

## 1. *Objectives*

No Change from proposal.

## 2. *Basic Research Issues*

These equipment items support projects currently funded by AFOSR and by complementing other equipment already available in our laboratories, enhance the research capabilities of the Center for Reliability of Ceramics at the University of Houston to address important issues in characterizing ceramic materials.

## 3. *Approach*

### Center for Reliability of Ceramics

This center seeks to develop the science and technology necessary for the advancement of engineering structures comprised of ceramic materials. A specific goal of each project under this center will ultimately contribute to a formal methodology for the prediction of engineering serviceability from microstructural and materials quantities, thereby, circumventing the inherent limitations of state-of-the-art statistical methods.

The uniqueness of this approach lies in the incorporation of material and microstructural quantities as an integral constituent of the reliability predictions. As such, reducing the various failure mechanisms to their elements permits the implementation of the Crack Growth Model, developed at the University of Houston, to predict component reliability. This Crack Growth Model, although not yet complete, offers a unique link between the elemental microstructural parameters and the stability of flaws in ceramic materials.

The blend of university and industrial participants is intended to provide a firm scientific basis for the wide range of issues germane to this task, while maintaining engineering relevance to current and future applications. The spectrum of disciplines invited to participate in this effort provides sufficient expertise for cross-pollination of new ideas for the development of novel solutions to those engineering and science problems that currently restrict the commercialization of ceramic components and products.

The scope of the center, which is the application of fundamental constitutive models to predict the behavior of engineering components, requires a close cooperation between the academic, national laboratories and the industrial partners. The center will study the following topics, which support the development of the science of mechanical behavior of ceramics, necessary to elevate the level of industrial involvement. To this end, the center must be successful in advancing the scientific principles which govern mechanical behavior on a scale comparable with the microstructure.

The center focus is on the following topics:

Ceramic Microstructures
Interfaces
Mechanics of Materials
Ceramic Design Concepts
Tribology

## 4. *Significant Results*

Equipment Purchased:
Nano Instruments, Inc. Model XP Indenter
TSL Orientation Image Microscopy (OIM) Attachment for the existing Center (CRC) SEM.
Sputter Coater: Cressington Model 108
Frame Grabber Equipment for Digital Image Correlation (DIC) equipment (computer purchased under separate funds)

## 5. *AF Relevance*

- Develop microstructure-based methods for design of improved toughness ceramics
- Initiate basis for component design methodology for brittle materials

### *Acknowledgment/Disclaimer*

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